

WHAT IS CLAIMED IS:

- 1 1. A method of interactively determining a camera position in a three-dimensional space from a two-dimensional image of objects in the three-dimensional space, the method comprising the steps of:
 - 4 selecting an object in the space to be a reference object;
 - 5 identifying a polygon in the image that corresponds to a planar facet of the reference object in the space;
 - 7 identifying at least one dimension of an edge of the reference object; and
 - 8 calculating camera parameters including a camera position from the polygon and the dimension.
- 1 2. The method of claim 1, wherein the step of calculating comprises:
 - 2 identifying parameterized geometric primitives in the space;
 - 3 determining the elements of the primitives, wherein an element is a spatial structure projectable onto the image;
 - 5 mapping features of the image to the elements to form correspondences; and
 - 6 solving for an objective function that minimizes an aggregate error between features of the image and projections of elements onto the image.
- 1 3. A method for generating remote presentations of products in situ comprising the steps of:
 - 3 a) prompting the user to capture a digital image of a space in which a product is to be viewed in context;
 - 5 b) prompting the user to identify the product from a set of products for which a three-dimensional geometric model exists or can be created;
 - 7 c) inputting at least one dimension reference, wherein a dimension reference is a measurement of a distance in the space corresponding to a separation of two points on the digital image;
 - 10 d) calculating, from the image and reference information, camera parameters for a camera in the space from which the image was captured, wherein the camera parameters include at least a camera position and a focal length;
 - 13 e) accepting an input of a product location, the product location being a location in the space where the product is to be in context;

15 f) transforming the geometric model of the product based on the camera position and
16 the product location to form a transformed geometric model; and
17 g) combining the transformed geometric model and the digital image to form a
18 modified image of the space where the modified image has been modified to
19 show the identified product in situ in the image with a proper proportion and
20 perspective.

1 4. The method of claim 3, further comprising a step of repeating step a)
2 for second and subsequent images of the space and using each of the provided images to
3 generate a geometric model of the space.

1 5. The method of claim 3, further comprising a step of repeating steps b),
2 e) and f) for second and subsequent selected products.

1 6. The method of claim 3, wherein the modified image of the space is a
2 two-dimensional view of a three-dimensional geometric model, the method further
3 comprising a step of moving a camera position of the modified image of the space to
4 simulate moving around in the space.

1 7. The method of claim 3, wherein the step of prompting the user to
2 identify the product from a set of products is performed using a commerce server that
3 serves product models and further comprising a step of transmitting the digital image to
4 the commerce server.

1 8. The method of claim 3, wherein the step of prompting the user to
2 identify the product from a set of products is performed using a commerce application
3 that receives product models and further comprising a step of transmitting the digital
4 image to the commerce server.

1 9. The method of claim 3, wherein the camera parameters include camera
2 position, camera rotation, focal length and center of projection.

1 10. The method of claim 3, wherein the reference information includes
2 correspondences between two-dimensional image features and three-dimensional
3 structures.

1 11. A commerce server for generating remote presentations of products in
2 situ comprising:
3 product image storage for storing product representations, wherein a product
4 representation is at least a product image taken of a three-dimensional product
5 and information usable to determine camera parameters of a camera that an
6 captured the product image, where camera parameters include at least a camera
7 position and a focal length;
8 means for receiving a digital image of a space in which a product is to be viewed in
9 situ;
10 space image storage for storing the digital image of the space;
11 parameter storage for storing at least one dimension reference, wherein a dimension
12 reference is a measurement of a distance in the space represented as a line
13 segment on the digital image;
14 a photogrammetric modeling engine having inputs to receive an image and
15 projections of lines from the space onto lines in the image and having an output
16 to output the camera parameters of the camera in the space from which the
17 image was captured;
18 means for receiving an indication from a client identifying one or more product from
19 a set of products form the product image storage;
20 inputs for receiving one or more product location, a product location being a location
21 in the space where the product is to be in situ;
22 a visual reconstruction engine having an input to receive the digital image of the
23 space from the space image storage, an input to receive camera parameters for
24 the digital image from the photogrammetric modeling engine, an input to receive
25 one or more product representation for selected products as indicated by the
26 means for receiving an indication, and an output for outputting a geometric
27 model of elements of the space including the selected products; and
28 a renderer for rendering a combination of geometric models of the one or more
29 product and the space, using a set of camera parameters common to each.

1 12. An apparatus for generating a three-dimensional geometric model
2 from a two-dimensional image of a three-dimensional space having objects therein, the
3 apparatus comprising:

4 a photogrammetry engine with an image input for accepting the two-dimensional
5 image and a primitives output for outputting primitives and parameters that
6 describe geometric elements of the objects in the image; and
7 a solid modeler with a primitives input for inputting primitives and parameters output
8 by the photogrammetry engine and a model output for outputting the geometric
9 model, wherein the solid modeler further includes means for modeling an object
10 in the space with a primitive shape or a mathematical operation of more than one
11 primitive shape.

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